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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention]

This invention relates to the constituent which reforms the fluororesin which is excellent in abrasion resistance and creep resistance, and can be used for a moving part, a seal article, packing, a gasket, a container, a jig, piping for semiconductor manufacture, etc., and its Plastic solid.

[0002]

[Description of the Prior Art]

The fluororesin is excellent in low friction nature, heat resistance, an electrical property, chemical resistance, or clean nature (non-stain resistance).

It is widely used for industry and a noncommercial various application.

However, wear and the creep modification of the fluororesin were large under a sliding ring boundary and the compression environment in an elevated temperature, and there was a case which cannot be used. For this reason, the measures which improve wear and creep modification have been taken by adding bulking agents, such as glass fiber and carbon fiber, to a fluororesin. However, by such a technique, when the mating materials which slide were soft metals, such as aluminum, there was a problem of shaving a mating material and making it damaged. Various bulking agents are examined as this solution.

[0003]

Although there are polyamide imide resin, aromatic system polyester resin, etc. as a bulking agent which does not damage a mating material, Even if it added these to the fluororesin, under a high speed, high load, or a cruel sliding ring boundary, like the surface roughness of the other party to slide is large, it was not necessarily able to be said that abrasion resistance and creep resistance were enough.

[0004]

On the other hand, without adding a bulking agent, the fluororesin itself is reformed and there is a refining fluororesin shown in the patent documents 1 to make the wear-resistant outstanding slide member profitably like.

[0005]

[Patent documents 1]

JP,2000-129019,A

[0006]

[Problem(s) to be Solved by the Invention]

However, in this refining fluororesin, it was not able to be said under the too cruel sliding ring boundary that abrasion resistance and creep resistance were enough.

[0007]

Therefore, the purpose of this invention is to provide the refining fluorine resin composition which can realize the original good characteristic of a fluororesin, and its Plastic solid, without having abrasion resistance and creep resistance outstanding under the severe sliding ring boundary, and moreover damaging a mating material.

[0008]

[Means for Solving the Problem]

In order to attain the above-mentioned purpose, a refining fluorine resin composition of this invention, A refining fluororesin reformed by irradiating with an ionizing radiation where a fluororesin for refining is heated under an inert gas atmosphere more than the melting point, an unmodified fluororesin, and polyamide imide resin are contained.

[0009]

It is desirable for weight of five weight sections - 50 weight sections, and said polyamide imide resin to be [for weight of said refining fluororesin] five weight sections - 20 weight sections to full weight to full weight, and for total weight of a refining fluororesin and polyamide imide resin to be ten weight sections - 60 weight sections to full weight.

[0010]

Said fluororesin for refining is at least one or more sorts chosen from a tetrafluoroethylene system polymer, a tetrafluoroethylene perfluoro (alkyl vinyl ether) system copolymer, and a tetrafluoroethylene hexafluoropropylene system copolymer.

[0011]

Similarly said unmodified fluororesin A tetrafluoroethylene system polymer, They are at least one or more sorts chosen from a tetrafluoroethylene perfluoro (alkyl vinyl ether) system copolymer and a tetrafluoroethylene hexafluoropropylene system copolymer.

[0012]

Said fluororesin for refining or an unmodified fluororesin shall be a tetrafluoroethylene system

polymer, and shall contain a different-species fluoro monomer not more than 1 mol % further.

[0013]

As for said refining fluoro resin, it is desirable for crystallization heat quantity to be 40 or less J/g, and for the melting point to be 325 ** or less.

[0014]

Said refining fluoro resin should be formed by [which irradiated with an ionizing radiation in the range of exposure dose 1kGy - 10MGy where it is under an inactivation gas atmosphere of 10 or less torr of oxygen densities and a fluoro resin for refining is heated more than the melting point] carrying out.

[0015]

A refining fluoro resin reformed when irradiating with an ionizing radiation, where a refining fluorine resin-molding object of this invention is heated [a fluoro resin for refining] under an inert gas atmosphere more than the melting point, A refining fluorine resin composition containing an unmodified fluoro resin and polyamide imide resin is fabricated in predetermined shape.

[0016]

[Embodiment of the Invention]

As a fluoro resin the object for refining, and unmodified used for this invention, A tetrafluoroethylene system polymer (it is described as the following "PTFE"), a tetrafluoroethylene fluoroalkoxy trifluoro ethylenic copolymer (it is described as the following "PFA"), A tetrafluoroethylene hexafluoropropylene copolymer (it is described as the following "FEP") and a polytetrafluoroethylene perfluoro dioxy sole copolymer (it is described as the following "THF/PDD") are mentioned.

[0017]

the polymerization unit based on copolymeric monomers, such as perfluoro (alkyl vinyl ether), hexafluoropropylene, ethylene (perfluoroalkyl), or chlorotrifluoroethylene, in the inside of the above-mentioned PTFE -- less than 0.2 mol % -- what is contained is contained. In the case of the above-mentioned fluoro resin, a little third components can also be included in the molecular structure.

[0018]

As for the melting point of the refining fluoro resin used in this invention, it is desirable for 325 ** or less and crystallization heat quantity to be 40 or less J/g. When these values are exceeded, abrasion resistance and creep resistance will fall remarkably. It is preferred that 305 ** or less and crystallization heat quantity consider it as 26 or less J/g in the melting point when a fluoro resin is PFA, and when it is FEP, it is preferred that 275 ** or less and crystallization heat quantity consider it as 11 or less J/g in the melting point.

[0019]

For evaluation of the above-mentioned heat characteristic, using a differential scanning calorimeter (DSC), among 50-360 °C with 10 °C/min and temperature fall speed of 10 °C/min. Temperature up, According to JIS K7122, crystallization heat quantity was calculated from the peak area which made the temperature fall the melting point and was surrounded [temperature fall] by the exothermic peak and baseline at the time of the 2nd temperature fall in the endothermic peak temperature of the two-cycle repetition and the DSC curve at the time of the 2nd temperature up.

[0020]

The refining fluoro-resin used in this invention can be manufactured by irradiating with an ionizing radiation in the range of exposure dose 1kGy - 10MGy in the state where are under the inactivation gas atmosphere of 10 or less torr of oxygen densities, and the fluoro-resin for refining was heated more than the melting point.

[0021]

In this invention, a gamma ray, an electron beam, X-rays, a neutron beam, or high energy ion is mentioned as an ionizing radiation used for reforming treatment.

[0022]

When irradiating with an ionizing radiation, it is necessary to heat the fluoro-resin for refining beyond the crystalline melting point. For example, in using PTFE as a fluoro-resin, To irradiate with an ionizing radiation in the state where it heated to a temperature higher than 327 °C which is the melting point of this material and use PFA and FEP, it is necessary to heat to a temperature higher than the melting point with which the former is specified as 310 °C and the latter is specified as 275 °C, and to irradiate with radiation.

[0023]

It becomes possible to make the molecular motion of the main chain which constitutes a fluoro-resin activated, and to, promote the crosslinking reaction between molecules of heating a fluoro-resin more than the melting point efficiently as a result. However, since excessive heating comes to cause cutting and decomposition of a molecule main chain conversely, cooking temperature should be held down inside to the range higher 10-30 °C than the melting point of a fluoro-resin.

[0024]

The refining fluorine resin-molding object of this invention can be acquired by filling up the metallic mold which has specified shape with the refining fluorine resin composition mentioned above, and fabricating it by predetermined pressure.

[0025]

As a use of the refining fluorine resin-molding object by this invention, broad uses, such as slide members, such as a roll for a-less lubricous bearing, a dynamic seal, and copying machines and bearing putt, and a semiconductor related manufactured part, are expectable. It

is also possible to use together solid lubricants, such as a molybdenum disulfide and graphite, etc. according to a use, and to raise lubricity.

[0026]

[Example]

Hereafter, based on an example and a comparative example, this invention is explained concretely, and the effect of this invention is proved.

[0027]

As the fluoro-resin for refining, and an unmodified fluoro-resin, PTFE powder (the Asahi Glass Co., Ltd. make, trade name--192) was used, and polyamidoimide powder (the Amoco make, a trade name: Torlon 4000TF) was used as polyamide imide resin. Carbon fiber (the Kureha Chemical Industry make, a trade name: KUREKA chop M-2007S), a molybdenum disulfide (Dow Corning make and trade name: MORIKOTOZ), and graphite (product [made by TIMCAL] and trade name: TIMREX KS6) were used as other additive agents.

[0028]

Refining performed the above-mentioned PTFE under oxygen density 1torr and a nitrogen atmosphere by carrying out the 100kGy exposure of the electron beam (accelerating voltage 2MeV) under 340 ° temperature. This was pulverized in mean particle diameter of 20 micrometers with the jet mill.

[0029]

By the combination presentation which shows such materials in the following table 1, material temperature and ambient temperature were mixed as 15 ° using the mixer. The obtained compound was pressurized for 5 minutes by 50MPa using the metallic mold with a phi45x height of 80 mm, and it took out from the metallic mold after compression molding, and calcinated under atmospheric pressure in 360 °x 2 hours. However, the gross weight of refining PTFE and polyamide imide resin carries out compression molding and calcinates with atmospheric pressure continuously at ordinary temperature for 360 °x 2 hours about Example 4 of 30 or more weight sections, the comparative example 3, and the comparative example 4. Then, the rod was produced by carrying out compression molding of the whole metallic mold by drawing moulding pressure 20MPa under ordinary temperature.

Thus, the produced rod was started to the prescribed dimension by cutting, and the specimen was produced.

[0030]

[Table 1]

配合組成（重量部）

組成	実施例				比較例				
	1	2	3	4	1	2	3	4	5
P T F E	82	77	80	68	77	82	57	57	77
改質 P T F E	10	10	15	20	20		43	10	10
ポリアミドイミド樹脂	5	10	5	10		15		30	
2 硫化モリブデン	3	3			3	3		3	3
グラファイト				2					
カーボン繊維									10

[0031]

Next, the characterization of a sample is explained. The measurement size considered it as each three samples, and made these arithmetic averages average value.

[0032]

(1) Tractive characteristics

The examination was done based on JIS K7161 by specimen 0.5 mm in thickness, and tensile test speed 200 mm/min.

[0033]

(2) Antiwear characteristic

Use a thrust wear testing device for an examination, and it applies to JIS K7218 correspondingly, It is a specimen (the outer diameter of 25.6 mm) to the cylindrical rings made from SUS304 (the outer diameter of 25.6 mm, and 20.6 mm in inside diameter). 20.6 mm in inside diameter and 1 mm in thickness were performed to lamination and a mating material on condition of pressure 1MPa and speed 50 m/min using ADC12 board (30 mm long, the side of 30 mm, 5 mm in thickness, surface roughness Ra0.4micrometer). measuring the weight loss after 24 hours -- a ratio -- abrasion loss V_{SA} was calculated from the following formula. About mating material damage, it investigated by the weight change before and behind a wear test.

$$V_{SA} = V / (P \cdot L)$$

V: Abrasion loss, P: test force, L : average slide distance

[0034]

The obtained characteristic (tractive-characteristics, antiwear characteristic) result is shown in the following table 2.

[0035]

[Table 2]

特性結果

特性		実施例				比較例				
		1	2	3	4	1	2	3	4	5
引張特性	引張強さ (MPa)	16.8	13.4	14.6	12.5	21.8	25.3	15.1	11.2	12.6
	伸び (%)	360	280	370	250	390	350	340	160	120
耐摩耗特性	比摩耗量 ($\times 10^{-8} \text{mm}^3/\text{Nm}$)	60	25	18	10	3500	7300	2300	9600	1900
	摩擦係数	0.20	0.18	0.25	0.20	0.26	0.34	0.30	0.36	0.27
	相手材の損傷	なし	なし	なし	なし	なし	なし	なし	あり	あり
	相手材の重量変化 (mg)	2.8	3.5	3.6	3.6	1.8	0.8	2.0	-1.8	-2.2

[0036]

Each Plastic solid of this example which comprises the presentation which made the subject PTFE, refining PTFE, and polyamide imide resin has good tractive characteristics, and they excelled the above-mentioned result in the antiwear characteristic. After the wear test, when the above-mentioned material formed a transition film, weight increased the aluminum of the mating material, and damage was not seen.

[0037]

On the other hand, under the high conditions of planar pressure, in the comparative example 4 which has low abrasion resistance, and many especially additions of polyamide imide resin, weight decreased and each Plastic solid of the comparative examples 1-4 damaged the mating material. In the comparative example 5 which added bulking agents other than polyamide imide resin, the mating material was shaved and damage was seen.

[0038]

When tractive characteristics and an antiwear characteristic excellent in the Plastic solid of this example can be given, damage can be suppressed also to elastic metal like aluminum and the application range of a fluororesin is extended so that clearly also from contrast of the above example and comparative example, it contributes greatly.

[0039]

[Effect of the Invention]

Since the refining fluorine resin composition of this invention contains polyamide imide resin other than a refining fluororesin, it becomes possible to give the abrasion resistance which was excellent without damaging a mating material under a severe sliding ring boundary, and creep resistance.

[0040]

The weight of said refining fluororesin to full weight Five weight sections - 50 weight sections, The weight of said polyamide imide resin is five weight sections - 20 weight sections to full weight, and the total weight of a refining fluororesin and polyamide imide resin by considering it

as ten weight sections - 60 weight sections to full weight, The above-mentioned abrasion resistance and creep resistance can be given, and the original good characteristic of a fluororesin is not spoiled.

[0041]

It becomes possible by fabricating the above-mentioned refining fluorine resin composition in predetermined shape, and considering it as a refining fluorine resin-molding object to use for broad uses, such as slide members, such as a roll for a-less lubricous bearing, a dynamic seal, and copying machines, and bearing putt, and a semiconductor related manufactured part.

[Translation done.]